ENGINEERING CHANGE NOTICE

Page 1 of 2

1. ECN 635511

Proj. ECN

2. ECN Category (mark one)	3. Originator's Name, Organization, MSIN, and Telephone No.	4. USQ Required?	5. Date
Supplemental [] Direct Revision [X] Change ECN [] Temporary [] Standby [] Supersedure [] Cancel/Void []	John H. Baldwin, Data Assessment and Interpretation, R2-12, 373-4533	[] Yes [X] No	07/25/97
	6. Project Title/No./Work Order No.: Tank 241-C-104	7. Bldg./Sys./Fac. No.: 241-C-104	8. Approval Designator: N/A
	9. Document Numbers Changed by this ECN (includes sheet no. and rev.): HNF-SD-WM-ER-679, Rev. 0	10. Related ECN No(s).: N/A	11. Related PO No.: N/A

12a. Modification Work	12b. Work Package No.	12c. Modification Work Complete	12d. Restored to Original Condition (Temp. or Standby ECN only)
[] Yes (fill out Blk. 12b) [X] No (NA Blks. 12b, 12c, 12d)	N/A	N/A Design Authority/Cog. Engineer Signature & Date	N/A Design Authority/Cog. Engineer Signature & Date

13a. Description of Change

13b. Design Baseline Document? [] Yes [X] No

This ECN was generated to include additional explanatory text in the best-basis narrative, and to update the comprehensive radionuclide inventory estimates for the tank.

Rev. 0 pages included for duplicating purposes only.

14a. Justification (mark one)

Criteria Change	[]	Design Improvement	[X]	Environmental	[]	Facility Deactivation	[]
As-Found	[]	Facilitate Const	[]	Const. Error/Omission	[]	Design Error/Omission	[]

14b. Justification Details

Initial release of this document was deficient.

15. Distribution (include name, MSIN, and no. of copies)

See attached distribution.

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ENGINEERING CHANGE NOTICE

1. ECN (use no. from pg. 1) ECN-635511

16. Design Verification Required	17. Cost Impact						18. Schedule Impact (days)	
	ENGINEERING			CONSTRUCTION				
[] Yes	Additional	[]	$	Additional	[]	$	Improvement	[]
[X] No	Savings	[]	$	Savings	[]	$	Delay	[]

19. Change Impact Review: Indicate the related documents (other than the engineering documents identified on Side 1) that will be affected by the change described in Block 13. Enter the affected document number in Block 20.

SDD/DD	[]	Seismic/Stress Analysis	[]	Tank Calibration Manual	[]
Functional Design Criteria	[]	Stress/Design Report	[]	Health Physics Procedure	[]
Operating Specification	[]	Interface Control Drawing	[]	Spares Multiple Unit Listing	[]
Criticality Specification	[]	Calibration Procedure	[]	Test Procedures/Specification	[]
Conceptual Design Report	[]	Installation Procedure	[]	Component Index	[]
Equipment Spec.	[]	Maintenance Procedure	[]	ASME Coded Item	[]
Const. Spec.	[]	Engineering Procedure	[]	Human Factor Consideration	[]
Procurement Spec.	[]	Operating Instruction	[]	Computer Software	[]
Vendor Information	[]	Operating Procedure	[]	Electric Circuit Schedule	[]
OM Manual	[]	Operational Safety Requirement	[]	ICRS Procedure	[]
FSAR/SAR	[]	IEFD Drawing	[]	Process Control Manual/Plan	[]
Safety Equipment List	[]	Cell Arrangement Drawing	[]	Process Flow Chart	[]
Radiation Work Permit	[]	Essential Material Specification	[]	Purchase Requisition	[]
Environmental Impact Statement	[]	Fac. Proc. Samp. Schedule	[]	Tickler File	[]
Environmental Report	[]	Inspection Plan	[]		[]
Environmental Permit	[]	Inventory Adjustment Request	[]		[]

20. Other Affected Documents: (NOTE: Documents listed below will not be revised by this ECN.) Signatures below indicate that the signing organization has been notified of other affected documents listed below.

Document Number/Revision	Document Number/Revision	Document Number Revision
N/A		

21. Approvals

	Signature	Date		Signature	Date
Design Authority			Design Agent		
Cog. Eng. J.H. Baldwin	John Baldwin	8/26/97	PE		
Cog. Mgr. K.M. Hall	Kathleen M. Hall	8/26/97	QA		
QA			Safety		
Safety			Design		
Environ.			Environ.		
Other			Other		

DEPARTMENT OF ENERGY

Signature or a Control Number that tracks the Approval Signature

ADDITIONAL

Tank Characterization Report for Single-Shell Tank 241-C-104

John H. Baldwin
Lockheed Martin Hanford, Corp., Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-96RL13200

EDT/ECN: ECN-635511 UC: 2070
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Key Words: Waste Characterization, Single-Shell Tank, SST, Tank 241-C-104, 241-C-104, C-104, C Farm, Tank Characterization Report, TCR, Waste Inventory, TPA Milestone M-44

Abstract: This document summarizes the information on the historical uses, present status, and the sampling and analysis results of waste stored in Tank 241-C-104. This report supports the requirements of the Tri-Party Agreement Milestone M-44-10.

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RECORD OF REVISION	(1) Document Number HNF-SD-WM-ER-679	Page 1

(2) Title
Tank Characterization Report for Single-Shell Tank 241-C-104

CHANGE CONTROL RECORD

(3) Revision	(4) Description of Change - Replace, Add, and Delete Pages	Authorized for Release (5) Cog. Engr.	(6) Cog. Mgr. Date
0	(7) Initially released 05/21/97 on EDT-617656.	J.H. Baldwin	K.M. Hall
0-A RS	Incorporate per ECN-635511.	J.H. Baldwin John Baldwin	K.M. Hall Kathleen M Hall 8/27/97

3.0 BEST-BASIS STANDARD INVENTORY ESTIMATE

Information about the chemical and/or physical properties of tank wastes is used to perform safety analyses, engineering evaluations, risk assessments associated with waste management activities, and to address regulatory issues. Waste management activities include overseeing tank farm operations and identifying, monitoring, and resolving safety issues associated with these operations and with the tank wastes. Disposal activities involve designing equipment, processes, and facilities for retrieving wastes and processing the wastes into a form that is suitable for long-term storage. Chemical inventory information is derived using two approaches: 1) component inventories are estimated using the results of sample analyses; and 2) component inventories are predicted using a model based on process knowledge and historical information. The current model was developed by Los Alamos National Laboratory (LANL) (Agnew et al. 1996b). Information derived from these two different approaches is often inconsistent.

An effort is underway to provide waste inventory estimates that will serve as the standard characterization information for the various waste management activities. As part of this effort, evaluation of available chemical information for tank 241-C-104 was performed that included:

1. Data from three core samples taken in 1986 and 1996 (Weiss and Schull 1988) and the statistical analysis results from the 1996 sampling event for this tank (Appendix B).

2. Component inventory estimates provided by the Hanford defined waste (HDW) model (Agnew et al. 1996a).

3. Evaluation of CWP1[1] and CWP2[2] wastes based on the fuel and waste transaction records and fuel fabrication records.

4. Analysis of CWP1/CWP2 sludge based on common sludge layers in tank 241-C-105 and the waste transaction records for tanks 241-C-104 and 241-C-105.

5. Analysis of the PUREX flowsheet , thorium campaign records and the composition of OWW3[3] waste, together with the waste transaction records for tank 241-C-104.

[1]PUREX cladding waste (1952-1960)

[2]PUREX cladding waste (1961-1972)

[3]Organic wash waste from PUREX process (1968-1972)

6. Analysis of residual metal waste based on the composition of tank 241-C-104 metal waste (MW).

7. Evaluation of the estimated thermal loads provided by the sample-based inventories of ^{90}Sr and ^{137}Cs relative to thermal modeling results for this tank.Based on this analysis, a best-basis inventory was developed. The 1996 cores (and for Al, Mn and PO_4, average values for the 1986 core and two 1996 cores) were used to generate estimates for the chemical and radionuclide components in this waste. The waste in tank 241-C-104 primarily consists of PUREX coating (CWP1 and CWP2) waste, PUREX zirconium cladding (CWP/Zr) waste, $BiPO_4$ MW, OWW3 waste, PUREX TH waste, PUREX high-level (P) waste, with small amounts of various other wastes. The best-basis inventory estimates for tank 241-C-104 are presented in Tables 3-1 and 3-2.

Table 3-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-C-104 (January 31, 1997). (2 sheets)

Analyte	Total Inventory (kg)	Basis (S, M, or E)[1]	Comment
Al	67,450	E	Weiss and Schull (1988), Appendix B
Bi	< 4,120	S	
Ca	< 4,120	S	
Cl	911	S	
CO_3	55,000	S	
Cr	1,660	S	
F	39,400	S	
Fe	31,400	S	
Hg	664	M	Agnew et. al. (1996b)
K	< 1,960	S	
La	< 2,060	S	
Mn	6,800	S	
Na	203,000	S	
Ni	3,000	S	

Table 3-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-C-104 (January 31, 1997). (2 sheets)

Analyte	Total Inventory (kg)	Basis (S, M, or E)[1]	Comment
NO_2	41,600	S	
NO_3	22,300	S	
OH	283,000	C	
Pb	< 4,120	S	
P as PO_4	8,230	S	
Si	11,600	S	
S as SO_4	< 12,360	S	
Sr	< 412	S	
TOC	16,100	S	
U_{TOTAL}	61,100	S	
Zr	73,900	S	

Notes:

n/r = not reported

[1]S = Sample-based
M = Hanford defined waste model-based
E = Engineering assessment-based
C = Charge balance

Table 3-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-C-104 (Decayed to January 1, 1994). (3 sheets)

Analyte	Total Inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{3}H	10.2	M	
^{14}C	0.84	S	Weiss and Schull (1988)
^{59}Ni	26.3	M	
^{60}Co	610	S	Appendix B
^{63}Ni	2,590	M	
^{79}Se	15.1	M	

Table 3-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-C-104 (Decayed to January 1, 1994). (3 sheets)

Analyte	Total Inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{90}Sr	624,000	S	Appendix B
^{90}Y	624,000	E	Based on ^{90}Sr
^{93}Zr	65.5	M	
^{93m}Nb	55.7	M	
^{99}Tc	3,740	S	Weiss and Schull (1988)
^{106}Ru	0.114	M	
^{113m}Cd	14.9	M	
^{125}Sb	9.20	M	
^{126}Sn	24.2	M	
^{129}I	0.0157	M	
^{134}Cs	0.734	M	
^{137}Cs	123,000	S	Appendix B
^{137m}Ba	116,000	E	Based on ^{137}Cs
^{151}Sm	56,300	M	
^{152}Eu	14.9	M	
^{154}Eu	1,880	S	Appendix B
^{155}Eu	< 1,850	S	Appendix B
^{226}Ra	0.00488	M	
^{227}Ac	69.4	M	
^{228}Ra	22.2	M	
^{229}Th	0.493	M	
^{231}Pa	125	M	
^{232}Th	1.23	M	
^{232}U	18.9	M	
^{233}U	72.5	M	

Table 3-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-C-104 (Decayed to January 1, 1994). (3 sheets)

Analyte	Total Inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{234}U	17.6	M	
^{235}U	0.691	M	
^{236}U	0.773	M	
^{237}Np	0.0279	M	
^{238}Pu	102	M	
^{238}U	14.8	M	
$^{239/240}$Pu	5,827	S	Appendix B
^{241}Am	7,150	S	Appendix B
^{241}Pu	6,890	M	
^{242}Cm	0.582	M	
^{242}Pu	0.0401	M	
^{243}Am	0.0327	M	
^{243}Cm	0.0535	M	
^{244}Cm	2.05	M	

Notes:

n/r = not reported

[1]S = Sample-based
M = Hanford defined waste model-based
E = Engineering assessment-based

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APPENDIX D

EVALUATION TO ESTABLISH BEST-BASIS INVENTORY FOR SINGLE-SHELL TANK 241-C-104

An effort is underway to provide waste inventory estimates that will serve as standard characterization source terms for the various waste management activities (Hodgson and LeClair 1996). As part of this effort, an evaluation of available information for tank 241-C-104 was performed, and a best-basis inventory was established. This work, detailed in the following sections, follows the methodology that was established by the standard inventory task.

D1.0 CHEMICAL INFORMATION SOURCES

This section describes the sampling campaigns that have been performed to establish the waste composition profiles in tank 241-C-104. In July, 1996, two push mode core samples were obtained from risers 3 and 14 of tank 241-C-104. Core 162 from riser 3 contained 4 segments, with the top of first segment located approximately 63.5 cm (25 in.) below the anticipated top of the sludge surface and the bottom of segment 4 about 2.54 cm (1 in.) above the bottom of the tank due to an undocumented offset in the elevation of the riser spool. The second core, core 165 from riser 14, was a full-depth core consisting of 6 segments.

These samples were analyzed for chemical and radionuclide composition of the waste. Various sample preparation methods were used, including water, acid, and potassium hydroxide (KOH) fusion digestions to dissolve the solids. Analyses performed included ICP analysis of metals, IC analysis of anions, GEA, AEA and mass spectroscopy for analysis of radionuclides. Analyte recoveries were verified by means of laboratory control samples, carriers, tracers, and surrogates that were analyzed concurrently with the samples. Other laboratory tests included TGA, DSC, specific gravity, TOC and percent moisture analysis. Analyte concentrations from core segments and core composites were statistically analyzed to establish mean values for each analyte.

A third core sample was also obtained from riser 8 in April, 1986. This core consisted of 6 segments which were combined to generate a composite sample for chemical and radionuclide analysis of the waste (Weiss and Schull 1988). Metals and radionuclides were analytically measured after water digestion of the original sample, acid digestion of the acid insoluble residue and strong acid (HNO_3-HF-HCl) digestion of the acid insoluble fraction. All of the acid insoluble residue was dissolved. Metals were determined by ICP, while anions were measured by IC.

The waste history of this tank is provided in other references (Anderson 1990). Tank 241-C-104 was removed from service in 1980, partially isolated in 1982, and salt well pumped on various occasions until 1989 (with only a minimal amount of saltwell pumping after 1986). The 1986 and two 1996 core samples are considered to be representative of the current inventory in the tank. Component inventories can be calculated by multiplying the mean concentration of an analyte by the appropriate volume and density of the sludge and liquid layers in the tank. The HDW model (Agnew et al. 1996) also provides an independent set of estimates for component inventories in this tank.

D2.0 COMPARISON OF COMPONENT INVENTORY VALUES

The 1986 core and one of the 1996 cores (core 165) contained 6 segments each, while the other 1996 core (core 162) is comprised of 4 segments. Table D2-1 provides data on the segment recoveries from the cores together with the projected depth of the sludge layer based on the physical dimensions of the sampler. Each segment is 48.3 cm (19 in.) long, 2.54 cm (1 in.) in diameter, and has a maximum volume of 244.5 cm^3 (14.9 in.^{3}).

Segment recoveries were identified as percent recovered based on the theoretical volume of the sampler. These cores show that the average sludge depth beneath the risers is about 253.6 cm (99.8 in.), which is higher than the measured depth of 221.7 cm (87.3 in.) as of January, 1993 (Swaney 1993) but slightly lower than the 260.9 cm (102.7 in.) depth cited by Hanlon in the Waste Status Summary Report (Hanlon 1997).

Table D2-1. Core Segment Recoveries and Sludge Layer Depth Estimates for Tank 241-C-104. (2 sheets)

Date	Riser	Core	Segment	Percent Recovered	Percent Solids	Percent Liquids	Segment Depth cm (in.)
1986	8	-	1	32	100	0	15.2 (6)
			2	100	100	0	48.3 (19)
			3	100	100	0	48.3 (19)
			4	100	100	0	48.3 (19)
			5	100	100	0	48.3 (19)
			6	100	97	3	48.3 (19)
						Total	256.7 (101)

Table D2-1. Core Segment Recoveries and Sludge Layer Depth Estimates for Tank 241-C-104. (2 sheets)

Date	Riser	Core	Segment	Percent Recovered	Percent Solids	Percent Liquids	Segment Depth cm (in.)
1996	3	162	1	92	100	0	48.3[1] (19)[1]
			2	97	100	0	48.3[1] (19)[1]
			3	100	89	11	48.3[1] (19)[1]
			4	92	89	11	48.3[1] (19)[1]
						Total	193.2[1] (76)[1]
1996	14	165	1	18	100	0	8.9 (3.5)
			2	100	100	0	48.3 (19)
			3	100	100	0	48.3 (19)
			4	100	100	0	48.3 (19)
			5	89	100	0	48.3 (19)
			6	95	100	0	48.3 (19)
						Total	250.4 (98.5)

Notes:

[1]Core 162 does not appear to have been a full-depth core.

Based on the average sludge level (of 253.6 cm [99.84 in.]) obtained from the core samples, tank 241-C-104 apparently contains about 1,087.6 kL (287.3 kgal) of waste, including 45.9 kL (12.1 kgal) because of the dished bottom configuration of the 22.86 m (75 ft) diameter tank. All of this waste consists of sludge. This inventory estimate is about 2.8 percent lower than the tank farm surveillance estimate of 1,116 kL (295 kgal) (Hanlon 1997). Because these values are relatively close, the tank farm surveillance estimate will be used in this analysis for the best-basis inventory.

Table D2-2 provides a summary of the composite sludge analytical results and tank inventory estimates based on the waste volume and solid segment sample density data (1,116 kL [295 kgal] and 1.69 kg/L, respectively, for the 1996 cores, and a density of 1.21 kg/L for the 1986 core). Liquid sample data was not used in estimating component inventories because only a minimal amount of liquid was found in the tank (17 kL of interstitial liquid). Because of the segment breakdown protocol and more complete analysis of the 1996 cores, including KOH fusion and statistical analysis of the analytes, the 1996 cores will be used as the basis for the tank inventory estimates in Table D2-2. The chemical species are reported without charge designation according to the best-basis inventory convention.

Table D2-2. Analytical Results and Sludge Inventory Estimates for Nonradioactive Components in Tank 241-C-104. (2 sheets)

Component	Mean Sludge Concentration in 1986 Core[1] (μg/g)	Mean Sludge Concentration in 1996 Cores[2] (μg/mL)	Total Tank Inventory[3] (kg)
Al	30,100	54,400	103,000
Sb	n/r	< 1,310	< 2,470
As	n/r	< 2,190	< 4,120
Ba	3,900	< 1,090	< 2,060
Be	n/r	< 109	< 206
Bi	3,640	< 2,190	< 4,120
B	17.1	1,080	2,040
Cd	1,280	620	1,170
Ca	11,300	< 2,190	< 4,120
Ce	n/r	< 2,190	< 4,120
Cl	n/r	483	911
Cr	1,120	882	1,660
Co	16.2	< 437	< 824
Cu	112	< 219	< 412
F	n/r	20,900	39,400
Fe	26,100	16,700	31,400
La	n/r	< 1,090	< 2,060
Pb	818	< 2,190	< 4,120
Li	n/r	< 219	< 412
Mg	5,460	< 2,190	< 4,120
Mn	3,280	4,240	7,990
Mo	n/r	< 1,090	< 2,060
Nd	n/r	< 2,190	< 4,120
Ni	1,910	1,590[4]	3,000[4]
NO_3	23,400	11,800	22,300
NO_2	n/r	22,000	41,600

Table D2-2. Analytical Results and Sludge Inventory Estimates for Nonradioactive Components in Tank 241-C-104. (2 sheets)

Component	Mean Sludge Concentration in 1986 Core[1] (μg/g)	Mean Sludge Concentration in 1996 Cores[2] (μg/mL)	Total Tank Inventory[3] (kg)
C_2O_6	n/r	3,390	6,390
P as PO_4	9,590	3,126	5,915
K	1,350	804	1,520
Sm	n/r	< 2,190	< 4,120
Se	n/r	< 2,190	< 4,120
Si	56,400	6,180	11,600
Ag	468	637	1,200
Na	95,500	108,000	203,000
Sr	81.2	< 219	< 412
SO_4	n/r	< 6,570	< 12,360
Tl	n/r	< 4,370	< 8,240
Ti	n/r	< 219	< 412
TIC as CO_3	n/r	29,300	55,000
TOC	4,410	8,550	16,100
U	16,100	32,400	61,100
V	n/r	< 1,090	< 2,060
Zn	117	604	1,140
Zr	61,800	39,200	73,900
Density	1.21 g/mL	1.69 g/mL	

Notes:

n/r = not reported

[1]Mean sludge concentrations for 1986 core from Weiss and Schull (1988).

[2]Mean sludge concentrations from 1996 sampling event for cores 162 and 165.

[3]Tank inventory based on 1,116 kL of sludge with an average density of 1.69 kg/L. The 1996 mean sludge concentrations were used.

[4]Because nickel crucibles were used in the KOH fusion, Ni results are based on acid digestion.

Table D2-3 provides a summary of the mean composite sludge radionuclide concentrations and tank inventory estimates based on the 1986 and two 1996 core samples. Radionuclide results in Table D-3 are reported as mean values and have been decayed to January 1, 1994. Original analytical values may be referenced in Weiss and Schull (1988) and in Appendix B.

Table D2-3. Analytical Results and Tank Inventory Estimates for Radioactive Components in Tank 241-C-104 (Tank Inventory Only Decayed to January 1, 1994, Except Total Alpha, Beta and Gamma).

Radionuclide	1986 core[1] (μCi/g)	1996 cores[2] (μCi/g)	Tank inventory[3] (Ci)
^{14}C	6.22E-04	n/r	1.17
^{60}Co	0.195	0.323	610
^{90}Sr	306	323	610,000
^{99}Tc	2.77	n/r	5,224
^{129}I	0	n/r	n/r
^{137}Cs	26.1	65	123,000
^{154}Eu	n/r	1.0	1,880
^{155}Eu	n/r	< 0.185	< 1,850
$^{239/240}Pu$	2.96	n/r	5,827
^{241}Am	3.11	3.79	7,153
Total Alpha	n/r	6.37	12,000
Total Beta	n/r	642	1.21E+06
Total Gamma	48.4	3.76	7,090

Notes:

n/r = not reported

[1]Based on decayed mean of 1986 core sample sludge (Weiss and Schull 1988).

[2]Based on decayed mean of 1996 core samples.

[3]Tank inventory based on 1,116 kL (295 kgal) of sludge with a density of 1.69 kg/L and all radionuclide values decayed to January 1, 1994. The 1996 mean sludge concentrations were used when available. In instances where the 1996 mean sludge concentration was not available, the 1986 mean sludge concentration was used.

6. Analysis of residual metal waste based on the composition of tank 241-T-101 MW (GE 1951).

7. Evaluation of the estimated thermal loads provided by the sample-based inventories of ^{90}Sr and ^{137}Cs relative to thermal modelling results for this tank.

Based on this analysis, a best-basis inventory was developed. The 1996 cores (and for Al, Mn and PO_4, average values for the 1986 core and two 1996 cores) were used to generate estimates for the chemical and radionuclide components in this waste. The waste in tank 241-C-104 primarily consists of PUREX process coating (CWP1 and CWP2) waste, CWP/Zr waste, $BiPO_4$ MW, PUREX process organic wash (OWW3) waste, PUREX process TH waste, PUREX process high-level (P2) waste, with small amounts of various other wastes.

Once the best-basis inventories were determined, the hydroxide inventory was calculated by performing a charge balance with the valences of other analytes. In some cases, this approach requires that other analyte (e.g., sodium or nitrate) inventories be adjusted to achieve the charge balance. During such adjustments, the number of significant figures is not increased. This charge balance approach is consistent with that used by Agnew et al. (1997).

The best-basis inventory for tank 241-C-104 is presented in Tables D4-1 and D4-2. A high level of confidence is assigned to the component inventory estimates for Al, Mn, Ni, Si, and Zr because of reasonable agreement between sample-based estimates and flowsheet derived estimates for these components. For all other components a medium level of confidence is assigned to the sample-based estimates, principally because of the "less than" values assigned by the statisticians, which indicates that a majority of the observations were below the detection level. The inventory values reported in Tables D4-1 and D4-2 are subject to change. Refer to the Tank Characterization Database for the most current inventory values.

Best-basis tank inventory values are derived for 46 key radionuclides (as defined in Section 3.1 of Kupfer et al. 1997), all decayed to a common report date of January 1, 1994. Often, waste sample analyses reported ^{90}Sr, ^{137}Cs, $^{239/240}$Pu, and total uranium, or (total beta and total alpha) while other key radionuclides such as ^{60}Co, ^{99}Tc, ^{129}I, ^{154}Eu, ^{155}Eu, and ^{241}Am etc., were infrequently reported. For this reason, it was necessary to derive most of the 46 key radionuclides by computer models. These models estimate radionuclide activity in batches of reactor fuel, account for the split of radionuclides to various separations plant waste streams, and track their movement with tank waste transactions. (These computer models are described in Kupfer et al. 1997, Section 6.1 and in Watrous and Wootan 1997). Model generated values for radionuclides in any of 177 tanks are reported in results Agnew et al. (1997). The best-basis value for any one analyte may be a model result, a sample, or engineering assessment-based result, if available. (No attempt was made to ratio or normalize model results for all 46 radionuclides when values for measured radionuclides disagreed with the model). For a discussion of typical error between model-derived values and sample-derived values, see Kupfer et al. (1997, Section 6.1.10).

Table D4-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-C-104 (January 31, 1997).

Analyte	Total Inventory (kg)	Basis (S, M, or E)[1]	Comment
Al	67,450	E	Weiss and Schull (1988), Appendix B
Bi	< 4,120	S	
Ca	< 4,120	S	
Cl	911	S	
CO_3	55,000	S	
Cr	1,660	S	
F	39,400	S	
Fe	31,400	S	
Hg	664	M	Agnew et al. (1996)
K	< 1,960	S	
La	< 2,060	S	
Mn	6,800	S	
Na	203,000	S	
Ni	3,000	S	
NO_2	41,600	S	
NO_3	22,300	S	
OH	283,000	C	
Pb	< 4,120	S	
P as PO_4	8,230	S	
Si	11,600	S	
S as SO_4	< 12,360	S	
Sr	< 412	S	
TOC	16,100	S	
U_{TOTAL}	61,100	S	
Zr	73,900	S	

Notes:

[1]S = Sample-based
M = Hanford defined waste model-based
E = Engineering assessment-based
C = Charge balance

Table D4-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-C-104 (Decayed to January 1, 1994) (2 Sheets)

Analyte	Total Inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{3}H	10.2	M	
^{14}C	0.84	S	Weiss and Schull (1988)
^{59}Ni	26.3	M	
^{60}Co	610	S	Appendix B
^{63}Ni	2,590	M	
^{79}Se	15.1	M	
^{90}Sr	624,000	S	Appendix B
^{90}Y	624,000	E	Based on ^{90}Sr
^{93}Zr	65.5	M	
^{93m}Nb	55.7	M	
^{99}Tc	3,740	S	Weiss and Schull (1988)
^{106}Ru	0.114	M	
^{113m}Cd	149	M	
^{125}Sb	9.20	M	
^{126}Sn	24.2	M	
^{129}I	0.0157	M	
^{134}Cs	0.734	M	
^{137}Cs	123,000	S	Appendix B
^{137m}Ba	116,000	E	Based on ^{137}Cs
^{151}Sm	56,300	M	
^{152}Eu	14.9	M	
^{154}Eu	1,880	S	Appendix B
^{155}Eu	< 1,850	S	Appendix B
^{226}Ra	0.00488	M	
^{227}Ac	69.4	M	
^{228}Ra	22.2	M	

Table D4-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-C-104 (Decayed to January 1, 1994) (2 Sheets)

Analyte	Total Inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{229}Th	0.493	M	
^{231}Pa	125	M	
^{232}Th	1.23	M	
^{232}U	18.9	M	
^{233}U	72.5	M	
^{234}U	17.6	M	
^{235}U	0.691	M	
^{236}U	0.773	M	
^{237}Np	0.0279	M	
^{238}Pu	102	M	
^{238}U	14.8	M	
$^{239/240}Pu$	5,827	S	Appendix B
^{241}Am	7,150	S	Appendix B
^{241}Pu	6,890	M	
^{242}Cm	0.582	M	
^{242}Pu	0.0401	M	
^{243}Am	0.0327	M	
^{243}Cm	0.0535	M	
^{244}Cm	2.05	M	

Notes:

[1]S = Sample-based
M = Hanford defined waste model-based
E = Engineering assessment-based

D5.0 APPENDIX D REFERENCES

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